

**Annual Progress/Technical Report for
Great Lakes Observing System (GLOS) Coordination**

Award Number: NA05NOS47311666

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Past year: June 1, 2006 – May 31, 2007

This past year covers the second full year of a three-year grant period. During this year, the Great Lakes Commission (GLC), acting as the Secretariat for GLOS Regional Association (GLOS-RA) and in conjunction with the newly-formed GLOS Regional Association's Board of Directors (GLOS Board), met all of its obligations under the grant. This progress report provides detailed information on how these obligations were met.

1) Program Summary

The Great Lakes Observing System Regional Association is a non-profit corporation registered in the State of Michigan, established to advance the goals and objectives of the U.S. Integrated Oceans Observing System (IOOS) across the Great Lakes – St. Lawrence River system. IOOS in turn is the U.S. oceans, coastal and Great Lakes component of the Global Earth Observing System of Systems (GEOSS). Further information on the GLOS-RA can be found at: <http://www.glos.us/>.

The GLOS-RA is committed to providing integrated, in-situ, and remotely-sensed information and numeric modeling about the Great Lakes, their interconnecting waterways, the St. Lawrence River, their tributaries, watersheds and airsheds for use by researchers, managers, industry, educators and others engaged in government, commerce, education, and science on or about the system. The GLOS-RA is also committed to promoting education and outreach to Great Lakes stakeholders about conditions and trends within the system and to informing policy makers and legislators about emerging issues and critical data requirements.

The GLOS-RA is expected to include membership from a wide variety of stakeholders across the region, including federal, state and municipal governmental agencies, Native American communities, academic institutions, commercial ventures, non-governmental organizations and end users of the region's resources.

2) Progress and Accomplishments

Work on the project has been on schedule throughout this past year.

- **RA Organizational Structure**

The Commission has continued to coordinate interagency and user involvement to initiate the GLOS-RA and its inaugural Board of Directors. The GLOS Board was constituted in April 2006. Listed below are the Officers and Directors of the GLOS-RA with their current titles and most recent affiliation.

Officers

Chairman - Mr. Bill Werick, retired Planner, U.S. Army Corps of Engineers, Culpepper, VA

Vice Chairman - Dr. Frank Kudrna, Kudrna & Associates Consulting Engineers, Chicago, IL

Treasurer - Dr. Alfred Beeton, Scientist Emeritus, NOAA Great Lakes Research Laboratory, Ann Arbor, MI

Secretary - Dr. Jeffrey Boehm, Vice President, John G. Shedd Aquarium, Chicago, IL

Directors

Dr. Gerald Galloway, University of Maryland, College Park, MD

Mr. Mark Grazioli, retired Principal, Wade Trim Consulting Engineers, Grosse Ile, MI

Mr. Philip Keillor, retired Coastal Engineer, WI Sea Grant, Madison, WI

Dr. Gail Krantzberg, McMaster University, Toronto, ON

Mr. Dale Phenicie, Council of Great Lakes Industries, Peachtree City, GA

Dr. Harvey Shear, University of Toronto, Mississauga, ON

Dr. Richard Stewart, University of Wisconsin-Superior, Superior, WI

Mr. Nelson Thomas, retired Water Quality Specialist, U.S. Environmental Protection Agency, Duluth, MN

The GLOS Board has impressive experience in dealing with Great Lakes issues, including economic development, industrial pollution control, municipal water system operations, ecological protection, binational coordination, public education and tourism, project plan formulation and implementation, information management and stakeholder conflict resolution. Further information on each member of the inaugural GLOS Board of Directors can be found at: <http://www.glos.us/about/board.php>. The GLOS-RA is well positioned to address the diversity of needs of the Great Lakes – St. Lawrence River system.

During this report period, the GLOS Board conducted several meeting, including:

- its first Annual Conference in Ann Arbor, MI on June 19-20, 2006;
- an in-person meeting in Chicago, IL on November 13-14, 2006; and
- its second Annual Conference in Niagara Falls, NY on April 12-13, 2007.

Monthly conference calls of the GLOS Board were also conducted during intervening months.

The June 2006 1st Annual GLOS Conference included presentations on the status of key observing system components, regional data management activities and education/outreach approaches. During its meeting, the GLOS Board formerly adopted bylaws for the organization. These bylaws are available at: <http://www.glos.us/bylaws/2006Bylaws.pdf>.

During the Board meeting on June 20, 2006, Mr. Roger L. Gauthier of the GLC staff was appointed as the interim executive director for GLOS. He is responsible for managing conduct of a variety of data, communications, budgetary, administrative, and staff oversight assignments. The responsibilities of the GLOS Executive Director are outlined in the GLOS Bylaws. The GLC will continue to provide staffing for the GLOS Secretariat through June 30, 2008, as a function of the current planning grant. The GLC is the recipient of funding for the GLOS-RA through that date. A Memorandum of Agreement between the GLOS Board and GLC Executive Director was approved in February 2007 to formalize commitment of manpower resources to support the GLOS initiative.

During this meeting, the GLOS Board established a committee structure, which includes committees for finance/auditing, personnel/elections, advocacy, membership, education/outreach, research, and binational coordination. Each committee would be led by a Director. This committee structure is outlined in the GLOS Bylaws. The Board also determined that the GLOS-RA would create a Program Review Panel (PRP) made up of representatives of its membership to provide input to the Board on establishing short-term (annual) and long-term (two to five year) resource allocation priorities. The PRP has not yet been constituted, as membership issues have yet to be resolved.

The Board met again on November 13-14, 2006 to develop procedures to assess proposed program/project relevancy and to define priorities for product development. During this meeting the Board approved formulation of expert subsystem teams, which would be constituted from recognized experts within the region. The subsystem teams would provide input to GLOS staff for preparation of annual work plans. During this meeting, the Board also developed a series of evaluation criteria to determine priorities for resource allocations and discussed value-added products that could be developed to meet IOOS societal goals within the Great Lakes – St. Lawrence River region.

The April 2007 2nd Annual GLOS Conference included presentations from each of the nine GLOS subsystem teams outlining their consensus opinions on near-term priorities for improvements in observing capabilities, model development, product development and education/outreach. The timing of this conference was planned to coincide with development of the final draft of a GLOS-RA Regional Coastal Ocean Observing System (RCOOS) proposal. Over 100 stakeholders were engaged in the development of this multi-year GLOS system development proposal. Over 30 separate comments were addressed before it was submitted to NOAA in late April.

Directors and Officers Liability Insurance has been purchased to partially indemnify officers of the Non-Profit Corporation.

An application for 501(c) 3 tax-exempt status through the Internal Revenue Service and has been on hold pending required organizational policy documents (Conflict of Interest Policy; Financial Operations Policy). These policies were recently adopted by the GLOS Board and the application will be submitted in July 2007.

The Board has discussed how to proceed with the creation of formal membership classes and dues structures. Starting in July 2007, the Board will use defined member roles, member responsibilities and membership benefits to solicit members from non-federal entities. Unfortunately, the IOOS leadership has not satisfactorily resolved legal interpretations regarding federal agency engagement with RAs, impeding creation of a full GLOS-RA membership program. The Great Lakes region has a major binational federal engagement in the research, design, operation, maintenance of observing systems. Without overt U.S. and Canadian federal agency engagement, GLOS can not fully meet its goals to plan, design, implement or operate an integrated observing system or create sustainable products that meet documented needs.

- **Planning and Implementation**

The inaugural GLOS Business Plan was completed in November 2004. The plan included: goals and objectives of the organization; needs assessment; outline of subsystems and components; procedures for product development and periodic review; approaches for data management and communication, research and development, and education and outreach; preferred governance model for the organization; funding opportunities; and, marketing approaches. The GLOS Business Plan is available at: http://www.glos.us/businessplan/GLOS_BP_2004.pdf. The business plan will be revisited in 2008 to reflect the interests of the GLOS Board, particularly with respect to lessons learned over the last four years regarding needed regional observing improvements and high-value integrated products.

A major focus of the GLOS-RA during this past year was the development of the first GLOS Annual Work Plan. This plan identifies key activities, implementation responsibilities, timelines and budgets for the GLOS-RA for the period July 1, 2006, through June 30, 2007. This annual cycle corresponds with most state financial years within the region and generally corresponds with the NOAA grant cycle that funds the GLOS-RA. The 2006-07 GLOS Annual Work Plan was adopted by the GLOS Board during its business meeting in June 2006. The work plan is available at: <http://www.glos.us/annualworkplan/2006-2007.pdf>.

- **Regional Observing Systems Coordination**

A major focus of the GLOS-RA during the past year has been continuing discussions with regional entities, primarily federal agencies, state departments, provincial ministries and academic institutions, to refine subsystem design and implementation planning for the period 2007-12. These coordination activities have engaged teams of subject matter experts in developing an integrated and cohesive vision for each of the following GLOS subsystems:

- Deep Water
- Scientific Ships
- Nearshore and Coastal
- Interconnecting Waterways
- Remote Sensing
- Atmospheric Monitoring
- Process Modeling and Ecological Forecasting
- Information Integration
- Education and Outreach

Subsystem Expert Teams

More than 75 regional subject matter experts from across the Great Lakes region have participated in the development of proposed work plans for the nine GLOS subsystems. Each of the nine subsystem teams conducted quarterly conference calls to determine near-term (first year) and long-term (2-5 year) priorities for observing system improvements and integrated products. For further information on the objectives of each subsystem team and its members: http://www.glos.us/subsystemteams/GLOS_Subsystem_Roster_2007.pdf.

Regional coordination of stakeholder engagement is a role that the GLOS-RA is evolving to provide. The GLOS-RA has also supported coordination efforts that have been undertaken by collaborating organizations. For example, GLOS staff has provided assistance to the Great Lakes Association of Scientific Ships (GLASS) in planning and conducting its annual meeting in January of each year. There are more than 100 members of the maritime community that convene on an annual basis to coordinate field data collection operations, share information resources and identify community priorities. Most of the Information Integration subsystem members are actively engaged in the planning and conduct of Great Lakes Regional Data Exchange (RDX) conferences and workshops. Most members of the Education/Outreach subsystem team are actively supporting a new Great Lakes Regional Research Information Network (GLRRIN) endeavor to better coordinate research activities across the region.

Regional coordination has continued in the design, development and implementation of the GLOS Data Management and Communication (DMAC) subsystem over this year. The eight Great Lakes states maintain geospatial data resources which can be rendered accessible through a GLOS web mapping portal. Data needs of the Coastal Zone Management (CZM) programs within the region have been inventoried and are the basis of current database design work.

Coordination of Federal Backbone Observations

Initial efforts have been focused on working closely with NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) to link delivery of their water level and meteorologic observations to the user community served by the Great Lakes Information Network (GLIN), see: www.great-lakes.net. Under the GLOS DMAC subsystem, GLC staff has designed interfaces to ingest NOAA/CO-OPS products into the GLOS web mapping application. GLC staff has begun to work with U.S. Geological Survey staff to import stream gauge observations into this web mapping application.

Near-term improvements to NOAA's Great Lakes CoastWatch products, including generation of daily lakewide surface products for chlorophyll, organic solids and surface sediment loads, have been explored. These new products could be produced from existing space-borne sensor arrays including MODIS, SeaWiFS and AVHRR and delivered to end users on a daily basis. Each of these three operational products are needed to monitor organic, contaminant and sediment loads to the Great Lakes, which in turn can be used to assess performances on meeting water quality management targets and to monitor harmful algal bloom development across the Great Lakes.

The CoastWatch Program currently generates surface temperature maps from daily satellite observations and buoys in the Great Lakes. The Great Lakes Sea Grant Network (GLSGN) has enhanced this effort by repackaging these maps for use by the charter fishing community, who rely upon this product extensively (estimated at 4,000 visits per week) to determine the location of temperature gradients where fish may congregate. The Remote Sensing subsystem is being designed to include existing CoastWatch products and identified new requirements.

During this past year, GLOS staff has continued to promote activities of the NOAA National Weather Service (NWS) National Data Buoy Center (NDBC) across the region. In particular, GLOS staff has followed up on issues identified in the July 2005 letters sent by the GLC to the Director of NDBC outlining the region's needs for additional sensor enhancements to the existing buoy network and densification of observation stations across the lakes. The observation programs of the NOAA-NDBC are a critical backbone component of the GLOS Open Water subsystem and are needed to improve nearshore marine forecasts. Maintenance of existing meteorologic observations at the Lake St. Clair C-MAN site is particularly important, including the additions of new observations of surface currents and biological activity. The Lake St. Clair installation is a key observation node needed to model contaminant transport mechanisms within the Lake Huron to Lake Erie Corridor (HEC).

NOAA's National Weather Service Central Region has undertaken an initiative to increase the density of coastal meteorological observations across the Great Lakes. This effort is in response to user needs for improved nearshore marine weather information and forecasts, and is designed to provide support as a component of the GLOS Nearshore subsystem. It proposes to expand the number of NOAA coastal meteorological observations by 50 percent before 2012 with placement of critical observations determined through a priority gap analysis conducted

collaboratively with NOAA-CO-OPS and NOAA-GLERL. To date, 10 new meteorological observation stations have been installed in the western Great Lakes with plans for installing additional platforms in 2007.

The GLOS-RA has been active in coordinating plans for the development and implementation of hydrodynamic modeling for the HEC, along with installation of dedicated Acoustic Doppler Current Profilers (ADCPs) in the St. Clair River, Lake St. Clair and the Detroit River. This activity is driven by the need to protect drinking water supplies for 4 million residents in southeast Michigan and southwest Ontario. These activities are components of the GLOS Interconnecting Waterway subsystem and engage elements in NOAA, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the U.S. Geological Survey, Environment Canada, and state and provincial agencies.

Regional DMAC Initiation

During this past year, GLOS-DMAC efforts have focused on the system design requirements for incorporating the following information resources:

- a comprehensive binational (U.S. and Canada) monitoring inventory;
- NOAA's CoastWatch Great Lakes products;
- framework geospatial datasets and detailed geospatial mapping of coastal, open lake and riverine conditions collected under the International Joint Commission's (IJC) Lake Ontario – St. Lawrence River Study;
- water level and meteorological observations produced by the NOAA CO-OPS program; and
- air emissions datasets from the eight Great Lakes states and the province of Ontario

The GLOS-DMAC has also been supporting re-design efforts of the Great Lakes Information Network (GLIN) to act as a comprehensive clearinghouse node for geospatial data collected and maintained over the region. Geospatial data, including those collected from open-lake moorings and remotely sensed observations are being factored into design of the GLOS-DMAC. A Service Oriented Architecture is the preferred approach for GLOS-DMAC design. GLOS technical staff and collaborators have attended relevant national DMAC meetings (OOS-Tech, DMAC Steering Committee, etc.) to insure that regional development is being conducted in concordance with rapidly evolving DMAC protocols and certification requirements.

The GLOS-DMAC architecture has identified the following critical factors:

- additional server capacity to support distributed geospatial data management;
- enhanced bandwidth to support data transport between federal, state and academic users;
- additional storage capacity to support regional data archiving and derived products;
- automated methods for ingesting data;
- multi-disciplinary product development teams; and,
- redesign of GLIN to support product distribution.

Data ingestion will involve real-time in-situ observations, computer modeling output and raster datasets. In-situ observational data taken from sensor platforms (e.g., water level gauges, buoys) would be ingested in real-time using open source protocols (e.g., XML, Web Services, netCDF). Modeled outputs would be added including estimated, interpolated and forecasted values, such as weather and lake circulation predictions.

Web products to be developed include dynamic maps of in-situ observations highlighting the spatial distribution of phenomena across the Great Lakes or within their interconnecting waterways. These products should include graphs, statistics and animations depicting both real-time and historical phenomena to showcase significant trends, events, and other features.

Product distribution is based upon evolving Web Services (e.g., Web Feature Service (WFS), Sensor Web Enablement (SWE) and SensorML formats) to ensure maximum interoperability and access to data. By utilizing common and standardized formats for data and using Web Services as a distribution channel, the GLOS-DMAC is designed to support a diverse group of end users, enabling the development of additional websites, further analysis, data conversion and other value-added operations.

- **Stakeholder Engagement**

Workshops, Meetings and Conferences Attended

Six key events were conducted or attended during this past year that affected GLOS planning, systems integration and regional DMAC design and implementation.

- 1st Annual GLOS Conference - On June 19-20, 2006 the GLOS Board conducted its first Annual Conference in Ann Arbor, MI. Approximately 60 attendees participated during the first day of the meeting, including members of the Steering Committee and Regional Interest Group. Presentations were made on the status of key facets of the initiative, including an overview of the governance model, subsystems design and legislative activities. The presentations are available at: <http://www.glos.us/mtgs/2006/index.php>. On the second day, the GLOS Board met and adopted its inaugural bylaws and addressed other administrative matters.
- State of the Lakes Ecosystem Conference (SOLEC) - On November 1-3, 2006, several members of the GLOS Board and Secretariat attended SOLEC meetings in Milwaukee, WI. SOLEC is a biennial conference conducted around the Great Lakes region that brings approximately 400 researchers and environmentalists together to assess progress towards meeting the objectives of the Great Lakes Water Quality Agreement (GLWQA) between the U.S. and Canada. The current list of SOLEC indicators includes key metrics for some 90 ecological conditions across the region. Many of these indicators have significant observational, data management and reporting requirements, which are frequently unmet. There is significant correspondence between the GLWQA objectives, SOLEC indicator

development and implementation and IOOS societal goals. The status of GLOS activities were presented in several sessions including GLWQA review, Lake Michigan monitoring coordination, climate change assessments and land use mapping. Implementation of high value SOLEC indicators is a major emphasis area within the Great Lakes Regional Collaboration recommendations, which can be realized through the GLOS initiative.

- NFRA Meeting / IOOS Regional Association Coordination Workshop - On November 6-9, 2006, several members of the GLOS Board and Secretariat participated in the NFRA Meeting and IOOS Regional Association Coordination Workshop conducted in Chicago, IL. Dr. Jeff Boehm, Vice President of the Shedd Aquarium and a GLOS Director, hosted the IOOS Workshop. The Shedd Aquarium was an excellent venue for information exchange between participants. The GLOS Board members developed an understanding of how regional efforts relate with national and international endeavors. They also made important contacts for future technology transfer opportunities. Another benefit derived from these meetings was learning about Ocean.US tools for determining priorities for observing system improvements.
- St. Lawrence Global Observatory (SLGO) Steering Committee Meeting – On November 16, 2006, GLOS staff met with the steering committee for the SLGO to lay the groundwork for coordination between these two initiatives. The SLGO Steering Committee includes representatives from various federal, provincial, academic and non-governmental agencies within Quebec. The SLGO objectives are to promote information integration downstream of Cornwall, Ontario / Massena, NY and throughout the Gulf of St. Lawrence. The SLGO effectively links the Great Lakes with the Northeast Atlantic Regional Association, since they share common areas along the Atlantic seaboard. This meeting was very beneficial to GLOS planning efforts, particularly with respect to coordination and linking of respective DMAC activities. SLGO is planning to support a Systems Oriented Architecture similar to that employed by GLOS and GoMOOS.
- Best Education and Outreach Practices from Observing Systems Workshop – On April 10-11, 2007, the Great Lakes Sea Grant Network, led by the Michigan Sea Grant program, hosted a two-day workshop that focused on defining education/outreach approaches that should be incorporated in IOOS planning efforts. Further information on this workshop can be found at: <http://www.miseagrant.umich.edu/glos/>.
- 2nd Annual GLOS Conference - On April 12-13, 2007 the GLOS Board conducted its second annual conference in Niagara Falls, NY. Approximately 60 attendees participated during the first day of the meeting, including members of the Subsystem Teams and Regional Interest Group. Presentations were made on subsystem team recommendations for projects to be included in the 2007 RCOOS grant solicitation. Further information on this meeting is available at: <http://www.glos.us/mtgs/2007/index.php>. On the second day, the GLOS Board met and revised its bylaws and addressed other administrative matters.

In addition to these very important meetings, GLOS Secretariat staff and/or Board members participated in the following events with a focus on coordinating GLOS implementation and subsystem prioritization efforts:

- Canadian Ocean Tech Workshop (focused on Ontario's engagement in Canadian Ocean Action Plan) – July 25, 2006, in Markham, ON;
- Great Lakes Regional Research Information Network Workshop – September 5-6, 2006, in Chicago, IL;
- Shared Waters Conference - September 14, 2006 in Kalamazoo, MI;
- Ocean Research Priority Plan Briefing – September 15, 2006 in Chicago, IL;
- ORION/OOOI Cyber Infrastructure Workshop – October 3-4, 2006 in Washington D.C.;
- Great Lakes Commission Annual Meeting – October 3-5, 2006 in Duluth, MN;
- NFRA Remote Sensing Workshop – October 3-5, 2006 in Durham, NH;
- Macomb/St. Clair Inter-County Water Quality Advisory Board meeting – October 16, 2006 in Detroit, MI;
- Binational Executive Committee Meeting – October 25, 2006 in Toronto, ON;
- Great Lakes Coastal Zone Managers Workshop – October 25-26, 2006 in Traverse City, MI;
- NetCDF Software Programming Workshop – October 30 – November 2, 2006 in Boulder, CO;
- Huron to Erie Corridor (HEC) Modeling Workshop – November 20, 2006 in Ann Arbor, MI;
- Macomb/St. Clair Inter-County Water Quality Advisory Board meeting – November 21, 2006 in Detroit, MI;
- Great Lakes Regional Research Information Network communications/outreach committee meeting – November 28-29, 2006 in Erie, PA;
- RDX Image Cataloguing Workshop – December 7-8, 2006 at U.S. Geological Survey, EROS Data Center, Sioux Falls, SD;
- Great Lakes Coastal Wetlands Consortium Science Committee meeting – January 22-23, 2007 in Duluth, MN;
- Great Lakes Pilot Association / GLASS Joint Conference – January 24-25, 2007 in Traverse City, MI;
- St. Lawrence Global Observatory Symposium – February 20-21, 2007 at the Canadian Space Agency, John H. Chapman Space Center, Longueuil, QC, Canada;
- Coastal GeoTools Conference – March 5-8, 2007 in Myrtle Beach, SC;
- NFRA Meetings – March 8-9, 2007 in Washington, D.C.;
- Great Lakes Coastal Wetlands Consortium Landscape Committee workshop – April 24-25, 2007 in Ann Arbor, MI;
- Coastal Change Assessment Program (C-CAP) applications discussion – May 2, 2007 at U.S. Environmental Protection, Region V and Great Lakes National Program Office in Chicago, IL
- Lake Michigan Monitoring Coordination Council meeting on National Monitoring Network pilot – May 9-10, 2007 in New Buffalo, MI;

- Great Lakes Commission Semi Annual Meeting – May 14-15, 2007 in Indianapolis, IN; and
- International Association of Great Lakes Research (IAGLR) 50th Anniversary Symposium – May 28-31, 2007 in State College, PA.
- GLOS/St. Lawrence Global Observatory coordination meeting with Environment Canada and Canadian Department of Fisheries and Oceans representatives from Ontario – May 30, 2007 in Burlington, ON.

New Partnerships

These six areas of regional coordination have major impact on GLOS' role across the region:

- GLWQA/BEC – Dr. Gail Krantzberg, a GLOS Director, briefed the Binational Executive Committee (BEC) about GLOS implementation status at their meeting in Toronto, ON on October 25, 2006. The BEC membership includes all U.S. and Canadian federal agencies engaged in implementing the Great Lakes Water Quality Agreement (GLWQA), with particular engagement of the U.S. Environmental Protection Agency and Environment Canada. The BEC coordinates monitoring efforts to implement the agreement, including water quality, atmospheric deposition and fish sampling conducted across the region. The BEC agreed to convene a workshop in early 2007 to coordinate various monitoring program activities, including those conducted under the auspices of GLOS. The GLWQA, signed between nations in 1972, is also undergoing periodic review to assess its current efficacy. The GLWQA has major sections dealing with monitoring protocols and research and surveillance approaches that are relevant to the mission of GLOS. The IJC, a binational treaty organization between countries, recently stated that the GLWQA should be replaced with a shorter and more action-oriented binational agreement. U.S. and Canadian federal agencies are still assessing alternate approaches. The GLOS-RA will continue to be engaged in these important discussions.
- U.S. / Canadian Binational Coordination – Mr. Roger Gauthier, the Interim GLOS Executive Director, has continued to work with managers of the St. Lawrence Global Observatory (SLGO), representing federal, provincial, academic and commercial partners in Quebec and members of the Ontario federal, provincial, academic and commercial sectors to develop a better binational focus for GLOS. GLOS has an inherent need to coordinate data transport with elements of Ontario monitoring programs, since most water bodies within the Great Lakes – St. Lawrence Region are international waters. Furthermore, horizontal connectivity needs to be insured with SLGO elements particularly dealing with flows, currents, meteorology and atmospheric contaminant pathways that link these two adjacent geographic areas.
- Ocean Research Priority Plan (ORPP) Comments – The GLOS Secretariat, in collaboration with the GLC and the IJC's Council of Great Lakes Research Managers provided comments on the final draft of the ORPP document entitled "*Charting the Course for Ocean Science in the United States: Research Priorities for the Next Decade.*" The ORPP outlines U.S.

national research priorities which would affect the Great Lakes – St. Lawrence River system over the next 10 years. The comments that were provided were highly influenced by research priorities identified under the Great Lakes Regional Collaboration effort. The quality of future research across the region will rely upon improvements in observational capabilities.

- Great Lakes Regional Collaboration (GLRC) Implementation – In December 2005, the GLRC released its strategy report for restoring and protecting the ecological resources of the Great Lakes. Initiation of GLOS as the regional component of IOOS and GEOSS was prominent in the recommendations in this report. The report reflects the work of more than 1,500 Great Lakes stakeholders and 12 months of consensus building. The GLRC was convened by the Great Lakes Interagency Task Force to provide stakeholder input as required in the Presidential Executive Order creating the task force. NOAA plays a key role on the Task Force. The GLOS-RA has been promoting implementation of monitoring and research recommendations included in the report.
- Great Lakes Regional Research Information Network (GLRRIN) – In September 2006, the GLRRIN was formally constituted, led by key members of the Great Lakes Sea Grant Network. The GLRRIN project is funded by NOAA's Sea Grant program for the next four years. It will develop individual networks for each of the Great Lakes to foster coordination of research activities and sharing of results across the region. The GLRRIN is patterned after the Lake Erie Millennium Network, an ad-hoc coordinating body facilitated by the Ohio Sea Grant Program and the University of Windsor. GLOS staffers are assisting the managers for GLRRIN in the development of communications, outreach and data management strategies.
- HEC/Lake St. Clair Management Plan Implementation – The GLOS Secretariat has been continually working with local counties in southeast Michigan, regional interests and Canadian federal and provincial representatives to promote observational improvement in the HEC, which includes Lake St. Clair. Regional coordination during this past year includes defining opportunities to implement recommendations of the Lake St. Clair Management Plan, released by the U.S. Army Corps of Engineers in 2004. Several of these recommendations deal with monitoring water quality, coastal habitat and nearshore processes throughout the lake. Particular emphasis has been placed on developing a three-dimensional hydrodynamic flow model of the HEC which could be run continuously by NOAA to support several of the IOOS societal goals within the sub-region.

Web Page Development

During this past year, the GLOS-RA further improved its website, including prototype development of a regional web mapping engine to provide user-friendly access to geospatial datasets. This GLOS website provides comprehensive access to:

- background information on the GLOS initiative, including contact information for the Board of Directors, the Subsystem Teams and the Regional Interest Group, the Business Plan, the 2006-07 Annual Work Plan, the GLOS Bylaws, and membership information;

- agenda and proceedings of all GLOS-RA meetings and conference calls;
- an events calendar;
- a user needs survey area;
- current lake conditions, including water levels, surface temperatures, meteorologic observations, weekly weather and water level forecasts, and links to an experimental buoy in Grand Traverse Bay;
- links to other collaborators including IOOS, other RAs, supporting agencies, Great Lakes regional partners and relevant publications;
- Great Lakes news stories including those on observations and monitoring programs across the region; and,
- past GLOS Update articles, including those written during this past year.

Education and Outreach

During this past year, the GLOS-RA concluded a memorandum of agreement with the GLSGN to implement an education and outreach campaign promoting the objectives of GLOS across the region. This broad public awareness campaign involves an oversight committee with representation from the seven programs in the GLSGN. The Committee meets via monthly conference calls, which commenced in September 2006. The 2006-07 Annual Work Plan identifies strategic activities for education and outreach activities, including:

- further assessments of user needs, gaps and deficiencies in existing services;
- design and promotion of a GLOS awareness campaign;
- development of promotional materials (e.g., fact sheets, news releases, newsletters); and,
- convening of workshops to highlight modeling and remote sensing initiatives.

Education efforts will build information-sharing relationships between data providers and educators and their students. Outreach efforts seek to engage and inform potential user groups and to gather their input on GLOS design, implementation and product delivery. Education planning is being coordinated with the Great Lakes Center for Ocean Sciences Education Excellence (COSEE). The Great Lakes COSEE was funded by the National Science Foundation in November 2005 to create dynamic linkages between Great Lakes and ocean research and education with the goal of enhancing scientific literacy and environmental stewardship.

Progress to date includes:

- formation of GLOS education and outreach teams;
- development of a “What is GLOS” Campaign;
- GLOS training for all GLSGN staff;
- GLOS education needs assessment, for formal (K-12) and informal education;
- evaluation and marketing of an enhanced GLOS website with readily accessible real-time information about lake conditions, including their physical, biological and chemical characteristics and associated forecasts and advisories;
- development of tools to enhance partnerships between research scientists and educators;

- pilot education projects in collaboration with the COSEE Great Lakes program, using Traverse Bay buoy data;
- building a comprehensive database of user observing needs;
- hosting thematic workshops and conferences to generate additional user input and to promote dialogue between users and GLOS governance/administrative functions;
- development and marketing of value-added products tailored to user group needs;
- promoting GLOS membership by advertising roles, responsibilities and benefits associated with the organization; and
- initiating binational outreach to promote Canadian participation in GLOS via presentations at the IAGLR Symposium in May 2007.

Other outreach activities include creation of periodic newsletters and implementation of a project Wiki. The GLOS Update e-newsletter is generated on a monthly basis, distributed to an increasingly wider user audience and posted on the web page. This communiqué was designed to provide GLOS and IOOS updates to a broad user community, including the Regional Interest Group and other partners. GLOS staffers have also been providing updates for the Alliance for Coastal Technologies' Great Lakes Regional Chapter newsletter and for the Ocean.US newsletter.

The GLOS Wiki was created to provide an additional channel for outside contributors to collaborate on the design and conduct of GLOS. The Wiki provides for a discussion forum between members of the GLOS Board, its committees, subsystem technical experts and others to exchange and archive information relevant to the endeavor.

Another key facet of outreach activities includes keeping congressional representatives apprised of ongoing developments across the region. GLOS staffers have provided input into the GLC's Annual Legislative Priorities on critical regional observing, monitoring and research needs that was presented at Great Lakes Day in Washington, D.C. on March 7, 2007.

3) Scope of Work

- **RA Establishment, Membership and Staffing**

The GLOS-RA is an established nonprofit corporation in the state of Michigan, with adopted bylaws, a formal governance structure and a mechanism for engaging stakeholder input for defining resource allocation priorities. Recognition of tax-exempt status by the Internal Revenue Service is pending but should be concluded within the next few months.

A formal membership policy has not been adopted by the GLOS Board, although draft roles, responsibilities and a dues structure have been discussed. The lack of formal membership has not hampered initial development of the GLOS-RA, since the majority of emphasis in early phases has been placed on using existing regional collaboration processes to define short-term priorities.

Staffing for the GLOS-RA at a level of approximately 2.2 full-time equivalents has been

provided by the GLC during this grant year. The GLOS Board and the GLC have formalized a working relationship under a Memorandum of Agreement.

- **Enhanced User Needs Assessment**

A cursory user needs assessment took place during development of the GLOS Business Plan submitted to NOAA in 2004. Over this past year, the GLOS Secretariat has continued to assess user needs in the following specific categories:

- water supply protection in southeast Michigan along the St. Clair – Detroit rivers / Lake St. Clair waterway;
- overlake remote sensing observations to support monitoring of nutrient and sediment loading; and,
- commercial navigation needs for improved channel conveyance forecasts for the St. Marys River, upper Great Lakes and the HEC.

Follow-on needs assessments were included in the outreach efforts conducted by the GLSGN. Additional needs assessments for observations to support the Great Lakes recreational boating community have not yet been conducted but will be pushed as part of the GLSGN outreach campaign, if funding allows over the next grant year. Of particular interest is the defining of prospective improvements to near-shore marine forecasts used by all mariners across the system.

In its strategy report released in December 2005, the GLRC recommended that specific activities be conducted by federal, state, county and municipal governments over the next five years to restore and protect Great Lakes ecological resources. These recommendations included a wide array of large-scale programs including restoration of coastal wetlands, protection of drinking water supplies, insuring safe public bathing beaches, and reduction of toxics and non-point pollution loadings, all of which require an improved observing framework across the system. These drivers for improving observing system functionalities are primarily focused on being able to adequately model and monitor spatial and temporal changes in loadings of contaminants, nutrients and sediments to the Great Lakes – St. Lawrence River system. The strategic goals expressed in the GLRC require both greater spatial density of meteorologic, chemical, biologic and physical observations and also enhanced integrated information resources including modeling and visualization.

One focal area of the GLRC Strategy Report was the Indicators and Information Strategy Team's appendix that outlined strategic improvements for observation and monitoring programs, implementation of indicator systems developed to measure progress, networking of information resources, research prioritization and improvements in communication systems. This annex outlines specific areas of focus for the GLOS-DMAC subsystem to address in years to come.

- **Subsystem Cost-Benefits Assessments**

Specific cost-benefit assessments for proposed GLOS regional observing subsystem components have not been conducted during this past year. They are being deferred until the needs assessments outlined above are fully completed. Methods will be developed in late 2007 to support long-term prioritization of resource allocations and funding for subsystem improvements that can be implemented with programmed funding resources.

4) Problems Encountered

The GLOS Business Plan was forwarded to Ocean.US and the NOAA Coastal Services Center in November 2004. To date, the GLOS-RA has not received any comments requiring revision. This document will need to be revised to reflect a more current portrayal of the organization, its programmatic objectives as defined by the GLOS Board and all other requirements identified for RA certification by Ocean.US.

Participation from all U.S. federal agencies engaged in the Great Lakes region still has not been fully achieved. Engagement of representatives from NOAA, the U.S. Fish and Wildlife Service, the U.S. Geological Survey and the U.S. Coast Guard has been consistent from the beginning of the GLOS-RA. During this past year, greater involvement has occurred by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers, but sustained engagement cannot yet be guaranteed. Canadian participation in the design and implementation of GLOS has improved with the appointment to the inaugural GLOS Board of two key academic representatives from Ontario universities with substantial systemic knowledge. Formal relationships with Ontario governmental agencies are still lacking, in spite of the fact that outreach to Quebec federal and state representatives has taken place.

Soliciting buy-in from state organizations, academic institutions and non-governmental organizations has been a continuing challenge, particularly since new funding has not yet been realized. Work conducted by the GLC Secretariat staff in support of the GLRC, particularly dealing with the Indicators and Information Strategy Team, has been instrumental in advancing the potential role of GLOS across the region. Continued engagement of the GLOS Board and Secretariat in the GLWQA review process over the next six months will highlight the importance of the contributions GLOS can make to monitoring and research coordination across the region.

Development of formal memoranda of agreement between the GLOS Board and major federal agencies within the Great Lakes – St. Lawrence River system is a daunting challenge, even if U.S. federal agencies are allowed to actively participate in RAs. NOAA has as many as 19 weather forecast offices under two regions. NOAA also has research facilities (e.g., GLERL) and other elements within the region. The USACE has three districts operating in the same domain. The USEPA has two regions covering the lakes, one national program office and one major research facility within the region. The USGS has one regional coordinator but eight district offices that would need to be signatories to any GLOS membership agreement. The NFRA and Ocean.US agencies need to provide more assistance in insuring that partnering occurs at the highest practical level.

Due to the binational nature of the Great Lakes – St. Lawrence River system, monitoring of the meteorology, hydrology, hydraulics, biology, chemistry and physical attributes of the system needs Canadian involvement. At present, engagement with Canadian counterparts is extremely limited, since there does not appear to be a commensurate investment within Ontario to promote a truly integrated observing system. Horizontal connectivity downstream between GLOS and the SLGO system in Quebec is less problematic, since an organizational commitment to data integration exists there. Binational coordination between U.S. and Canada needs to be promoted at higher levels by Ocean.US and by participating U.S. federal agencies.

5) New Areas of Emphasis

Due to the binational nature of the Great Lakes and the substantial influence of federal programs, the GLOS-RA will need to refine its priority setting procedures to better reflect emerging consensus about where observing improvements are needed. As such, the GLOS-RA needs to continue to refine its prioritization protocols to be more consistent with the systems engineering design strategy outlined by Ocean.US during the November 2006 workshop in Chicago, IL.

6) Leadership Personnel

There have been no changes in principal GLC staff supporting this project during this past year. A total of 2.2 full-time equivalent staffing has been provided by the GLC to support the GLOS-RA development during this grant period.

7) Budget Analysis

Work through November 30, 2006, has required the expenditure of 100 percent of the total funds provided under the second year of this multi-year grant (\$325,000.00).

Travel and contract expenses exceeded budget estimates, but were offset through savings in personnel, fringe benefits, indirect and equipment acquisitions.